

Castleford WwTW

new construction and refurbishment of existing assets to provide an increase in treatment capacity and improved performance

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Castleford WwTW is located on the outskirts of the town. The works serves the ancient Roman town of Castleford and receives flows from the new estate of Redhill and suburbs of Airedale & Ferry Frystone, which were local coal mining communities. In addition to receiving domestic sewage, Castleford WwTW receives a small trade flow; this trade flow includes discharges from Xscape leisure complex and Junction 32 Retail Park, which in 2011 received an estimated 2.48 million visitors. The original treatment works was built over 100 years ago and treated sewage through a process of preliminary treatment, horizontal flow primary settlement tanks, mineral media biofilters followed by humus settlement. Generated sludges were originally disposed onto sludge drying beds. This method was replaced by a sludge press and this was later updated to a single centrifuge.



Castleford WwTW: Aerial view of the site (January 2014) - Courtesy of Suave Aerial Photographers

Scheme drivers

To comply with the Freshwater Fisheries Directive (FFD) the ammonia discharge levels had to be reduced from 40 milligrams/litre (mg/l) to 10mg/l by 31 September 2014. To achieve this, the works was in need of modernisation and upgrading to increase its current treatment capacity and improve its discharge quality.

£16m of investment was allocated for the improvements to enable the works to serve a 2025 population equivalent of approximately 57,082; which is a 21.5% increase from present figures. As a result of the growth in population a further compliance date of 31 March 2015 was applied to the scheme. The current calculated full flow to treatment (FFT) is 217l/s, the improvement works will allow the site to treat a flow of 275l/s at a 2025 design horizon.

Scheme investigation

The investigation phase of the contract reviewed the client's notional solution to address their business risks; this comprised:

- Increased treatment capacity for 2025.
- New inlet works.
- Additional primary settlement.
- Additional secondary biological filters.
- Additional humus tank capacity.
- Additional nitrifying filters operated in alternating double filtration (ADF) mode.
- Interstage pumping as required.
- Additional sludge treatment assets.

Feasibility studies, optioneering exercises and collective cost reduction workshops demonstrated to the client that the notional solution (with a proposed cost of approximately £19m) did not offer best value.

The notional solution required a significant power demand and a high carbon footprint due to multiple process units and associated interstage pumping.

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Optioneering

Morgan Sindall Grontmij Joint Venture (MGJV) proposed that the treatment process to achieve the new tighter consent should be an activated sludge plant (ASP).

The proposed ASP along with works upgrades addressed all of the client's business risks and provided the client with an energy efficient solution when compared to other filter treatment options. The design reduced hydraulic losses and enabled the removal of interstage pumping of flows.

The solution could be constructed off-line which reduced the construction period and the risk of maintaining the existing process during the construction works. The client accepted the proposal as it offered the lowest capital cost and whole life cost solution.

Scope of works

The preferred solution at Castleford New WwTW comprised:

- New Redhill Inlet Pumping Station (15l/s).
- Refurbishment of the existing Airedale storm (200l/s) and FFT (60l/s) pumping stations (PS).
- New combined sewer overflow (CSO) for the Airedale inlet.
- Converted existing humus tank to new storm tank for Airedale flows (403m³).
- New inlet works comprising:
 - ▲ 3 (No.) fine screens (6mm 2D).
 - ▲ Refurbished existing screens handling units.
 - ▲ Grit removal: 1 (No.) detritor and classifier.
- Primary settlement tanks: 3 (No.) 20.75m diameter.
- Primary de-sludge PS: 2 (No.) RAM pumps (8.2 l/s).
- 4-lane activated sludge plant (7,676m³) including external anoxic zone (858m³).
- Delta hybrid blowers duty/assist/assist/standby (each 1,208Nm³/hr @ 670mBar).
- Membrane disc diffusers aeration system (EPDM membranes).
- Final settlement tanks: 3 (No.) 25m diameter.
- RAS/SAS PS.
- New sludge MCC building.
- 2 (No.) centrifuges including feed pumps (57m³/hr each).
- 2 (No.) sludge holding tanks (400m³ each).
- Powder poly dosing system.
- Return liquors PS.
- Washwater PS and associated booster set.
- Site security upgrades.

Early involvement

The scheme had a significant challenge to ensure that the most cost efficient solution was delivered. From the outset the project team worked collaboratively with the client and suppliers to undertake feasibility and to identify value engineering opportunities. This resulted in fewer assets, a reduced carbon footprint, reduced operator interface, lower power demand and a significant WLC saving.

Collaborative planning workshops were used to ensure there was common understanding of the drivers for the scheme and that there was emphasis to drive the programme to maximise all opportunities involving the supply chain.

Joint design meetings for the ASP were undertaken with the supply chain to ensure that the design of the mechanical and electrical plant was optimised.

3D modelling was used to coordinate the work by all the supply chain partners to avoid disruption, which resulted in the access steelwork being manufactured off site to reduce working at height. The model was also used for visualisation for operation and maintenance operations.



Castleford WwTW - Freshwater Fisheries Directive Compliance: October 2013 - July 2015

Key participants and supply chain partners

Client	Yorkshire Water
Principal contractor	Morgan Sindall Grontmij Joint Venture
Civil engineering	Ward & Burke Construction Ltd
Access steelwork	Nomenca Ltd
Aeration system	Suprafilt Ltd
Blowers	Aerzen
Inlet screens and grit removal system	Ham Baker Adams Ltd Tuke and Bell Ltd
Mechanical contractors	Powerrun Project Management Ltd Integrated Water Services Ltd
Electrical contractor	Circle Control & Design Systems Ltd
Panel supplier	Technical Control Systems Ltd
Software engineers	Blackburn Starling Ltd
CSO screen	CSO Technik Ltd
Rotating scraper bridges	A&J Water Treatment Ltd
Poly dosing, washwater & potable water	Northern Pump Suppliers Ltd
Centrifuges	Alfa Laval Ltd
Sludge conveyors	CTM Systems Ltd
Sludge mixing system	Monsal Ltd
Sludge storage tanks	Galglass Ltd
On-site temporary pumping solutions	Selwood Ltd



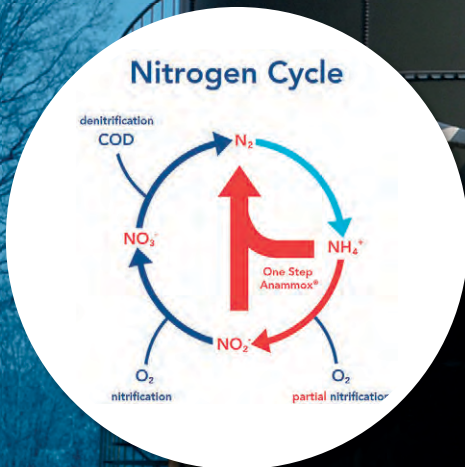
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Effective collaboration

The client had a regulatory obligation to have all construction and commissioning activities associated with the treatment process completed by 31 March 2015, which was 2 months prior to the MGJV planned completion date. MGJV achieved this through facilitating collaborative planning workshops with the client, designers, suppliers and subcontractors. This ensured that all parties were working towards a common goal and reduced conflict between trades, even identifying opportunities for shared resources, such as craneage.

The output from the collaborative planning workshops was a plan to enable the process plant to be brought into operation and fully commissioned prior to 31 March 2015, resulting in the client achieving their regulatory output early.

Throughout the project daily commissioning meetings were held with all on-site sub-contractors to raise awareness and ensure effective planning of the commissioning activities; the client attended these at least once per week.

Value engineering and innovation

Alternative design proposals were provided to the client through a process of investigation and diligent reporting. The final design challenged their specifications and asset standards resulting in them being revised to allow future projects to gain from the shared knowledge.

The deviations from the client's normal technical solutions provided a more efficient solution that reduced plant sizing, offered a large WLC saving and reduced construction costs by approximately £620,000. Examples of design innovation include:

- Optimisation of the design to remove a standby grit detritor/handling unit from the inlet works.

- Co-settling surplus activated sludge (SAS) from the ASP within the primary tanks, directly dewatering the mixed primary and secondary sludges using centrifuges. This solution negated the need for separate SAS storage tanks and associated thickening units/polymer equipment.
- Optimisation of the hydraulic profile to negate the need for an interstage pumping station.
- Collaboration with the supply chain to provide package solutions, resulting in improved build efficiency, reduced installation programme and a lower cost solution for the client.
- Remote Energy Visibility and Optimisation (REVO) technology has been used; this identifies the most efficient assets to run, depending on the energy tariff and the time of operation, saving both money and energy.
- Conversion of an existing humus tank into a new storm tank.
- Refurbishment and optimisation of an existing pumping station to facilitate multiple uses of a FFT and storm return PS.
- Using the new assets during the commissioning process to negate the need for costly temporary overpumping.

Yorkshire Water intends to use the Castleford scheme as a benchmark for delivering schemes in AMP6, and more specifically as a model for ASP design, build and commissioning.

Commissioning and performance

The commissioning of the ASP has been highly successful despite the compressed programme and seeding the ASP in the coldest period of the year, which is notoriously challenging when trying to achieve rapid nitrification. The risks and challenges were addressed by planning appropriately and working closely with Yorkshire Water. MGJV senior process engineer was heavily involved early throughout the project and was based on site during the seeding



Sludge handling facilities (February 2015) – Courtesy of Morgan Sindall Grontmij



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OF MATERIALS HANDLING EQUIPMENT.**

CTM are proud to have designed, manufactured and installed the radial skip distribution conveyors for the Sludge Treatment Plant at Yorkshire Water’s Castleford STW.

The scheme has been commissioned in 2015.



Installation of ASP aeration system (October 2014)
Courtesy of Morgan Sindall Grontmij



Installation of poly dosing system (March 2015)
Courtesy of Morgan Sindall Grontmij



Castleford WwTW - Commissioning the ASP (February 2015)
Courtesy of Morgan Sindall Grontmij



The new Castleford WwTW in operation (March 2015)
Courtesy of Suave Aerial Photographers

and optimisation process. This gave the client further confidence that the plant would perform to their requirements during commissioning and any issues would be swiftly resolved with minimum risk to the process.

Throughout this challenging process the team maintained a very close relationship with the operators, developing strong levels of trust.

The new works was constructed off line on an area within the existing site boundary. During the refurbishment works the existing process had to be maintained whilst the upgrades were completed prior to the existing works being decommissioned.

A phased commissioning process was undertaken to enable Yorkshire Water to meet the new ammonia consent of 10 mg/l by the consent date 31 September 2015, and the new inlet works and primary settlement tanks were brought online first. The flows through the new inlet works then needed to be passed to the existing filters for treatment.

To facilitate this and to reduce significant over pumping costs, the new ASP structure was modified to allow flows to gravitate from the external anoxic zone back through the existing process.

Five months later, the ASP and final settlement tanks were commissioned to meet the growth consent on 31 March 2015. The ASP was seeded within one week by importing thickened surplus activated sludge at 6% dry solids from a selected site with known healthy seed sludge. Once the desired tonnage of seed sludge was introduced into the lanes, full nitrification had occurred in the process and the new ASP was able to achieve consent, discharging directly to the river within 2 weeks of seeding.

This allowed temporary recirculation of the existing mineral media filters to be stopped saving significant OPEX and hire costs.

Once discharging to the River Calder the plant passed a 21 day performance and 14 day reliability test. To date the Castleford WwTW scheme is still ongoing, with the refurbishment of the existing Airedale FFT and storm PS, and decommissioning of the existing works being undertaken throughout this summer to meet the planned completion of the works in August 2015.

Conclusion

The Castleford project exemplifies open, honest and collaborative working to ensure the project's vision and strategy was met. The strong team ethos of working collaboratively has driven innovative solutions, creating significant cost savings which have enabled reinvestment back into the client business to address other needs.

Morgan Sindall Grontmij Joint Venture (MGJV) delivered the regulatory consent early and used innovative solutions such as utilising standard designs for the inlet works and centrifuges, the co-settling of surplus activated sludge and installation of package plants, manufactured off site.

The driver for the scheme was a new Freshwater Fisheries Directive Water Quality Consent to improve the quality of the River Calder and the new works has achieved an average reading of 0.2mg/l, against a compliance target of 10mg/l.

The site has reused and recycled materials, completed over 160,000 RIDDOR free hours, adding to MGJV's total of over 2,247,243 hours RIDDOR free.

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